Motorola
newsgram
Bi-Monthly Publication of Motorola Inc.
Communications and Electronics Division.

Jan - Feb, 1954

In this issue . . . NEW AIRBORNE "QUIK-CALL" SYSTEM FOR AIRCRAFT SELECTIVE CALLING.

ODDS AND ENDS

New Service

Lloyd P. Morris

We are inaugurating a new service in 1954. Lloyd P. Morris, Chief Engineer of our Systems Department, has been promoted to the position of Chief Engineer of the Motorola National Radio Systems Consulting Service. I think Lloyd Morris knows as much about 2-way radio systems as any man in the United States. He started with me in 1940 and he has been with me ever since. His practical work in the propagation field has been highly regarded throughout the country and has contributed markedly to the successful design of many complicated systems. Lloyd will devote 100% of his time to the design of customers' radio systems and to the solution of special systems problems. He will work with our Regional Managers in the service of our customers throughout the country.

Motorola Service Stations

Do you know that there are more than six hundred and fifty Motorola Authorized Service Stations, and not one is Motorola-owned. We pride ourselves on a policy of supporting the development and growth of independent service stations dedicated to the efficient maintenance of Motorola equipment.

Equipment Lease

To finance equipment without a large capital outlay, many corporations resort to the lease contract approach. Nowadays you can lease tires, trucks, automobiles, teletype machines, motion picture equipment, tools, and almost any other important product. The leasing of equipment in the mobile field is not a new approach; we have leased mobile equipment to power utilities for many years in the past. There are a couple of important differences between Motorola's leasing plan and the general run of contracts:

1. We will lease equipment to a customer without maintenance service, so that the customer may furnish his own maintenance.

2. The customer may terminate the lease at any time by purchasing the equipment with allowance for past payment. At the end of a lease period, the customer may purchase the equipment for a very nominal amount where the lease has been in effect for five years or more.

Six Slant Twelve

Motorola's use of the designation "6/12" for mobile equipment has a very special significance. This means a complete interchangeability from 6 Volts to 12 Volts without throwing switches, changing power supplies, or any other manipulation. The only requirement is that a 6 Volt car must have installed a set of 6 Volt cables, and a 12 Volt car must have installed a set of 12 Volt cables. With the installation of cables as indicated, the same complete mobile unit may be plugged into the cables of the 6 Volt car or the 12 Volt car without any changes whatever. This provides an obvious advantage where you have a mix of 6 and 12 Volt systems, since it is unnecessary to make any differentiation between the chassis used in one system or the other. It seems to be a very desirable feature to me, since it would achieve complete flexibility in the use of the equipment and simplify both the testing and maintenance setup.

Beyond the Horizon

You are going to hear a lot about "beyond the horizon" transmission, sometimes referred to as "forward scattering," in the next few years. The interest is very wide and interesting studies are underway in many scientific organizations, including the Motorola research group. There are many questions to be answered and problems to be solved. You may remember in the short discussion with you a couple of months ago, I suggested that a rhombic could be used with the 30-40 Mc. equipment to provide possible point-to-point communication over 150 to 300 miles. A couple of days ago, I had a discussion about this with Lloyd Morris and he suggested that, according to his calculations, superior gain could be achieved by using stacked Yagis on the transmitting towers at each end. The assumption was that my rhombic would be mounted on telephone poles at nominal height above the ground, while the Yagis would have a superior height factor which would enter into the gain calculation. I suggested that it is possible that the calculation should be determined by the beam width without using the height factor. If the height isn't important, the rhombic would give the best gain, and it is a much more practicable antenna to construct. Anyway, the point I wish to make is that no one knows whether the height of the antenna at the transmitting position is important or not for this forward scattering phenomenon. Some of the engineers are guessing that height is important, because the scattering effect appears to develop some distance from the source of the signal and the antenna system characteristics at the signal source may have the usual importance. Tilting the antenna directional array will also influence the forward scattering, but so far as I know, there is very limited data, and no quantitative conclusions can be reached. Eventually the data will be reduced to practical design formulas, and it's my guess that five years from now one hundred to three hundred mile hops, with UHF and microwaves, will be commonplace.

Dan Noble

The

Motorola Newsgram

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Communications and Electronics Division

Technical Information Center

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Motorola's new, 18-story high, display sign overlooking Chicago's lakefront. Story on page 31.

Please address all inquiries concerning sales, service or distribution to:

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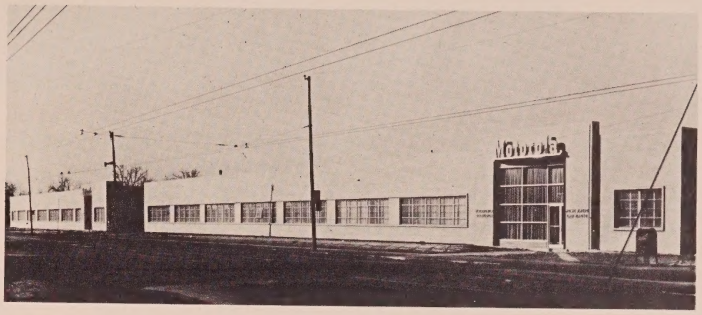


Motorola Expands Facilities

Because of the company's continued growth, Motorola has recently occupied two more major plants in the Chicago area.

As a means of consolidating operations, the company has taken over new plants on Chicago's West Side, less than a quarter mile from the main Consumer Division and Communications & Electronics Division headquarters.

Together the modern one-story buildings cover 150,000 square feet, with an equal area available for future expansion.

The screw machine division, stamping, plating, antenna assembly, tool and die shop and associated services of inspection, receiving, shipping, time study and methods, and offices are using the new plants.

One result of the move will be improved transportation, since many of these operations had previously been carried on in two remotely located plants.

Serving both plants will be a single personnel department, switchboard, guard system, first aid and maintenance operation. A cafeteria and black-top parking lots are provided for employees.

Physicist Appointed

Dr. Virgil E. Bottom has been appointed to the position of development physicist in charge of the Solid State Devices Development Group at Motorola's Research Laboratories in Phoenix, Arizona.

He heads a group of physicists and engineers developing transistors and other devices based on the flow of current in semi-conducting materials.

Prior to his appointment, Dr. Bottom was professor of physics and director of research in piezoelectricity and frequency control at Colorado A & M College.

He is holder of several patents in the field of quartz crystals for frequency control and filter applications.

Dr. Virgil E. Bottom

Dr. Bottom received his doctorate from Purdue University in 1949. His Ph.D. dissertation was on the electrical properties of Tellurium.

BALTIMORE COUNTY

Chief Orban (standing) and Chief Burke, in charge of communications, look over the dispatcher's desk.

• • • because the Baltimore County Fire Department uses 2-way radio to save seconds when seconds are vital. The firemen are more effective because they can exchange information freely. No life is lost, no property destroyed for lack of communication facilities.

One of the hottest fire departments in the country keeps Baltimore County citizens cool. Capably commanded by two men of foresight, Chief A. P. Orban and Deputy Chief Lee Cockey, the department fights fire with the most recently evolved weapons and techniques. Its communication system has been developed to such a point that nothing burns in the county for lack of a means of transferring information.

The Baltimore County group is one of the largest county departments in the east. The population of the county is approximately 270,000 in an area of approximately 645 square miles. The department consists of 40 companies. Of these, 13 located in 9 stations in the high value or congested area are fully paid companies and 27 are volunteer.

DISPATCHING

Communications system operation is simple and effective. A telephone operator and a dispatcher are stationed in the dispatch room in Towson. A manually operated recording device is connected to the switchboard to record all calls taken by the operator. The dispatcher sits before a desk on which are placed two VHF remote control consoles, one in operation and the other a standby unit, a 32-button Quik-Call Selector Box and two recording units. All radio messages, both incoming and outgoing, are recorded automatically with the recorders actuated by a self-contained voice operated relay. The Quik-Call equipment permits the dispatcher to control the volunteer station sirens individually by radio.

All fire calls in the county outside of the city of Baltimore are directed over the telephone system to the central station. The telephone operator passes the information to the dispatcher who calls the fire station nearest the fire over the radio network. If the station is staffed by paid firemen, he speaks to the local radio operator who takes the information and sounds the alarm. All further communication is conducted between the headquarters base station and the mobile unit in the dispatched truck or trucks.

However, if the nearest station is manned by volunteer firemen, the dispatcher selects the receiver at the proper station through the Quik-Call equipment. The receiver thus activated operates the local siren to summon the firemen. Once the firemen arrive at the station, they use the two-way mobile unit in the station vehicle to obtain further information from the dispatcher.

The ability to call back a dispatched truck as soon as it be-

In training, the firemen get the feel of working with radio.

SLEEPS SAFER . . . .

comes evident that it is not needed decreases costs and increases departmental effectiveness. Before radio, a truck a block from its station was out of reach. Thus, the economy effected by radio goes a long way toward amortizing the radio system's cost.

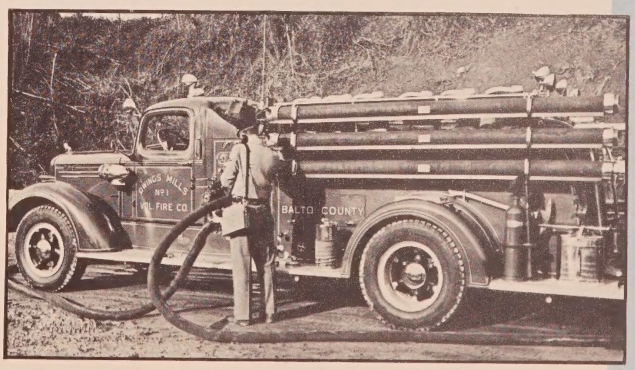
AT THE FIRE

At the fire, the group of firemen investigating the source of the fire carries a "Handie-Talkie" Radiophone. Once the type of fire is determined, the officer in charge calls outside to request the type of equipment needed. Later, he uses his "Handie-Talkie" Radiophone to direct the men who control the pressure in the lines. The portable radios are also used to coordinate the efforts of separated groups and to call men out of dangerous situations.

Another application, very important in an area as extensive as that covered by the Baltimore County Fire Department, is in controlling line pressure when pumping trucks are used in relay work. These lines sometimes extend as far as 7200 feet from water source to a fire. Pressure in these lines is maintained by four or five pumpers placed at intervals along the lines. Complete coordination between the men at the fire and the men at the trucks was impossible before the department obtained the portable radios.

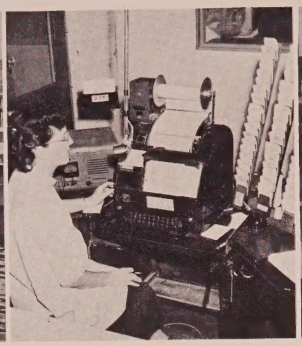
Application of these modern methods have marked the Baltimore County Fire Department as one of the most progressive in the country and they have made the Baltimore County citizen one of the best protected.

Pressure adjustment takes seconds instead of minutes when radio carries the messages.



Maintaining pressure in long lines is no problem with radio.

To patrol its miles of waterfront, Miami police use these radio-equipped motorboats.

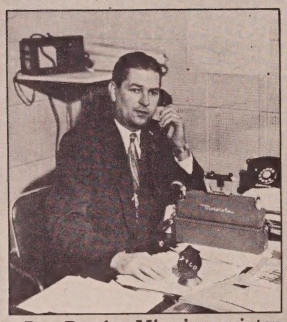


Teletype ties county offices with radio dispatch center.

All 14 fire stations are equipped with these 10-watt auxiliary units for close liaison.

Through 21 Years . . .

MIAMI—A LEADER IN PUBLIC SAFETY RADIO



Ben Demby, Miami superintendent of communication, co-ordinates a civil defense exercise via Motorola "Handie-Talkie" radiophone.

Among the nation's pioneer cities in the field of public safety 2-way radio is Miami, Fla., a bustling Southern city whose list of "firsts" reads like a chronology of the development of Fire and Police radio systems.

Starting in the early thirties when the city's growth curve began a marked upswing, radio has played a major part in the municipality's public safety program. Radio first was used effectively in 1933 when a base station on Collins Island in Miami Beach began transmitting instructions to nine one-way police patrol cars.

From this start, the value of radio dispatching became apparent, and late in 1935 the city fathers inaugurated a police department communications bureau. A young traffic patrolman named Ben C. Demby was placed in charge.

Under Demby's direction the communications bureau's 12 cars handled 14,000 calls during its first year. Simultaneously a period of extensive tests and experiments with 2-way mobile units began, and by October, 1936, the city management felt justified in expanding the bureau.

By this time units of the fire department had been equipped with radio, giving Miami the distinction of being the first metropolitan fire department in the United States to be fully equipped with 2-way radio. Today more than 450 firemen are organized in 22 combat companies, and all fire apparatus is radio-equipped. Fire Chief Henry Chase places high value on the equipment, saying:

"Time is the most precious element in firefighting efficiency, far beyond the dollars which good communications cost."

With full installation of 2-way radio in fire and police vehicles and in harbor patrol boats, the increase in efficiency prompted the Dade County sheriff and other law enforcement agencies to install radio facilities also.

Early 1944 also saw another "first" added to Miami's police record as 2-way radios were successfully used on solo motorcycles for the first time in any major U. S. city.

By March, 1944, Demby's police communications bureau had proved itself to the extent that the city commission created a separate Communications Division on a par with the fire and police

divisions. Ben Demby became its superintendent. Two-way radio had demonstrated its value; the basic communications plan was mature. Now there were technological problems to be met.

There were interference problems in the low frequency bands allocated to public safety use. Miami and police systems across the country were bothered by unwanted signals skipping beyond the intended range. Manmade noises were interfering seriously with emergency communications. It was at this time that Demby, in collaboration with Motorola, Inc., looked toward the 150-mc. frequency band for a solution to the interference problem.

Under Demby's supervision, lengthy tests were conducted, using equipment developed by Motorola's Communications & Electronics Division. Although many leading engineers took a dim view of effective mobile operations above 100 mc., the tests were successful and in 1944 Miami was the first U. S. city granted a license authorizing mobile operations above 100 mc.

At present Miami operates more than 350 mobile units in the 152-162 mc. band, using six frequencies to cover Dade County. Use of radio has mounted steadily. In 1948 the system handled 1,074,000 calls. In 1953 the number was estimated at 3,500,000—an average of six calls every minute.

Demby gives credit for this efficiency in part to his staff of women dispatchers, who work rotating shifts as radio dispatchers, teletype, IBM and switchboard operators. The officers on duty retain close supervision. In police work, for instance, the complaint sergeant receives all calls directly. The call to be dispatched is recorded on a log card, together with complete instructions, and is moved by conveyor belt to the dispatcher. The officer retains full control without having the burden of routine dispatching.

In 1952 Miami launched its latest innovation in public safety radio. It became the first city to utilize the 450 mc. band. To relieve congestion in the 160-mc. range, Miami with the assistance of Motorola engineers conducted mobile 2-way radio tests with 450 mc. equipment. The survey proved the feasibility of municipal 2-way mobile operation in this then practically unoccupied band.

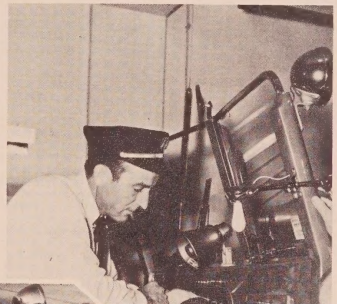
For many months now, a highly successful point-to-point 450-mc. radio control circuit has been operating between Miami and the Homestead, Fla., Police Department 30 miles away. Continued tests have been so favorable that a broad program of complete changeover of the city police from 160 mc. to the new 450 mc. equipment is under way.

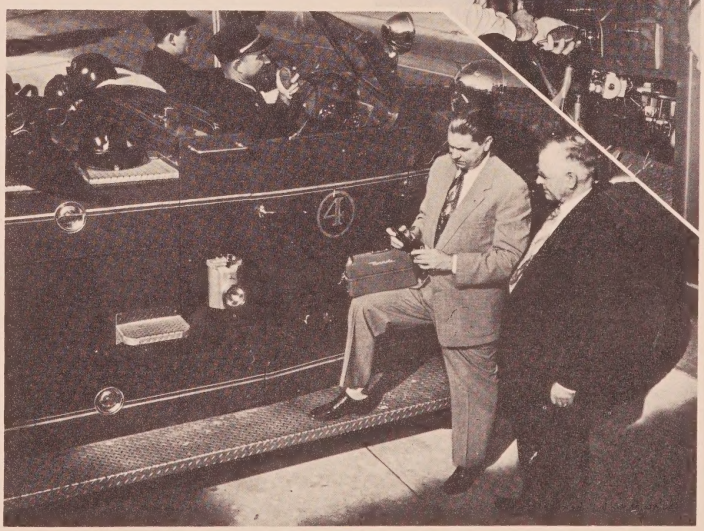
All of Miami's primary transmitting and receiving equipment is installed under the stands at the Orange Bowl on the city's outskirts, with antennas atop the stadium's floodlight towers. Auxiliary antennas and standby equipment are on top of the Dade County Courthouse.

Long a pacemaker in public service radio, Miami continues to be progressive. Radio instruction is included in the curricula of the Police Academy and Fire School. Operating procedure, code alphabets and radio technique are instilled in the recruit so that he may effectively make use of one of the most important tools he will have.

Radio is indeed a prime element of metropolitan public safety management as exemplified by Miami's Division of Communications.

Below: a directional loudspeaker helps override firetruck's high noise level.





Demby demonstrates the "Handie-Talkie" radiophone to Fire Chief Henry Chase, explaining how the portables have been used effectively at large blazes for inside-outside co-ordination.

Mrs. Harvey Buchholz presses the microphone button and relays messages instantly to Dr. Buchholz anywhere within a 40-mile radius.

DOCTOR SAVES TRAVEL TIME

RURAL PRACTICE THRIVES AND HE GAINS PRODUCTIVE HOURS BY USING 2-WAY RADIO

A common complaint among rural veterinarians is lack of communication with the office while they are out making routine calls. Returning to the office, they may find emergency calls from the area they had just left.

Dr. Harvey H. Buchholz of Wilton, Wisconsin, found an answer to this problem in two-way radio.

In 1950, aided by a Motorola radio communication engineer, he set up the first veterinarian two-way radio system in his state. After using radio three years, his findings offer help to those who have not yet installed their own radio systems.

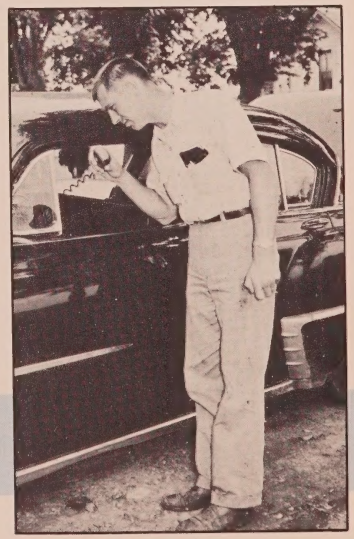
Most of his practice lies within a 20-mile radius in the heart of a major dairy producing area. In a year he averages 50,000 miles driving to and from clients' farms. Before he installed radio, Dr. Buchholz often spent eight hours a day on the road. Another four hours he spent practicing his profession. The notable improvement since the addition of radio has been the increase in time he can spend practicing and the accompanying decrease in travel time. Today he is on the road two to three hours less than before he installed radio.

MAKES MORE CALLS

Although his practice has increased because he can be reached immediately, Dr. Buchholz now has more leisure time to manage his 240-acre farm outside Wilton.

His wife operates the office radio, receives telephone calls for the doctor and relays the information to him, using either the remote control consolette in the office or an identical unit upstairs in their home.

A typical day will find the doctor starting out in the morning with two or three calls to make north of Wilton. While going from one farm to the next, or



Dr. Buchholz frequently finds special medicines needed in a hurry. Here he uses his mobile radio to order supplies sent to him at a dairy farm.

while at work on an animal, details of several other calls he can make nearby will be relayed to him by Mrs. Buchholz. By the time he returns home at noon, he will have made eight or nine calls and will not have to return to that area until the following day unless an emergency develops.

Because of the hilly terrain around Wilton, Buchholz' base station and antenna are located on a hill a quarter of a mile away from his office. A 60-watt transmitter gives complete coverage as far as 40 miles distant.

LICENSING SIMPLE

Veterinarians and physicians whose practices are mostly rural can easily qualify for licenses under the Federal Communications Commission's Special Emergency Section rules. The filing procedure is relatively simple, and a license for the system usually can be obtained in a few weeks' time.

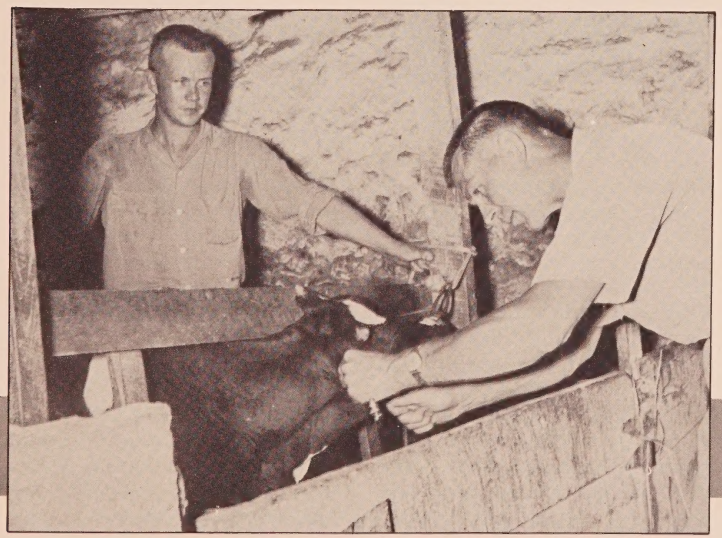
The FCC requires a restricted license for the base station operator, but no examination is necessary. Command of the English language and familiarity with regulations covering use of radio are all that is required.

A sturdy, well-designed 30-watt mobile unit such as Dr. Buchholz uses in his car and jeep costs $550 to $600, and a 30-watt desk-top local control base station, $750. Although the equipment will have returned its cost many times earlier, it may be amortized in five years.

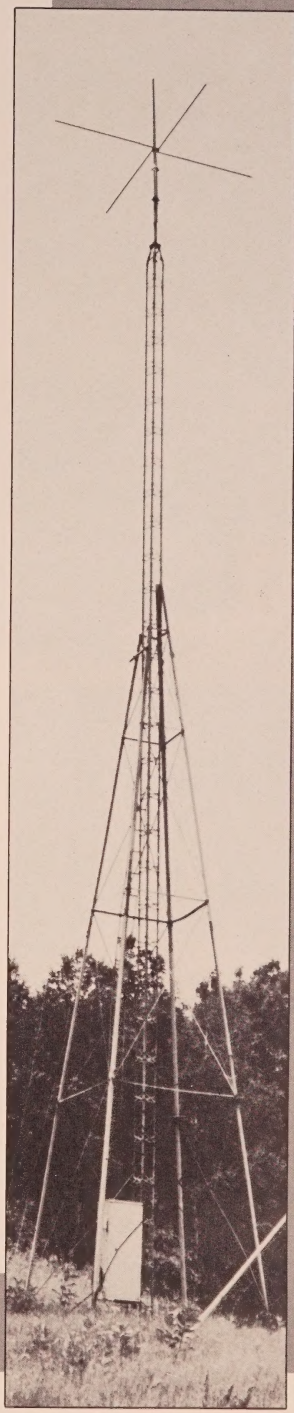
Maintenance usually can be arranged with a local radio service shop. Motorola has more than 700 authorized two-way radio service stations throughout the country.

The use Dr. Buchholz has made of radio is not isolated. More than 500 veterinarians have secured FCC licenses within recent years. They are finding that two-way radio is easy to obtain, easy to use and almost as necessary to the efficient practice of veterinary medicine as is their car.

Below: Dr. Buchholz administers penicillin to an ailing calf. Much of his rural practice is with cattle in the rich dairy producing area in Monroe County, Wis.

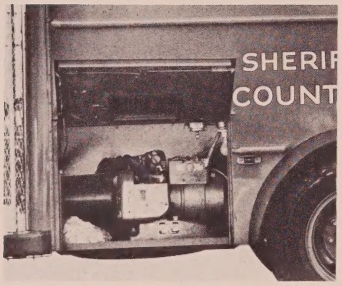


Right: A sturdy windmill tower helps support Dr. Buchholz' base station antenna. Transmitter and receiver are housed in a weatherproof cabinet at the base of the tower.

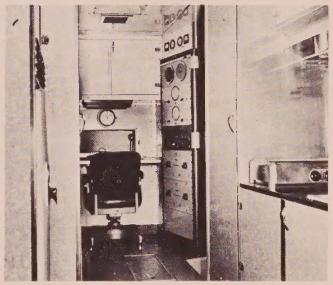


DISASTER PROOF COMMUNICATIONS

An underground concrete dispatching station and three microwave spans fortify the Los Angeles County Sheriff's radio system against unpredictable catastrophes.



Compartments on each side of the mobile center house the 3 kw. generators.



The radio operator's position in the mobile center is directly behind the driver.

The sheriff of Los Angeles County polices a 4084 square mile area populated by 4.5 million people. A job of this magnitude requires a large, efficient force armed with the latest police equipment and techniques. Fortunately, the sheriff has all this and more. His recently installed communication system was designed with foresight and imagination to all but eliminate the obstacles imposed by the exceptional size of the policed area.

In addition, every practical precaution against loss of radio communications in time of emergency has been taken.

The 250 vehicles and two airplanes operated by the sheriff's department are dispatched through a mostly underground, reinforced concrete central station. The station incorporates complete and comfortable facilities and is stocked with provisions so that the staff can carry on for an extended period without leaving during an emergency.

DISASTER CENTER

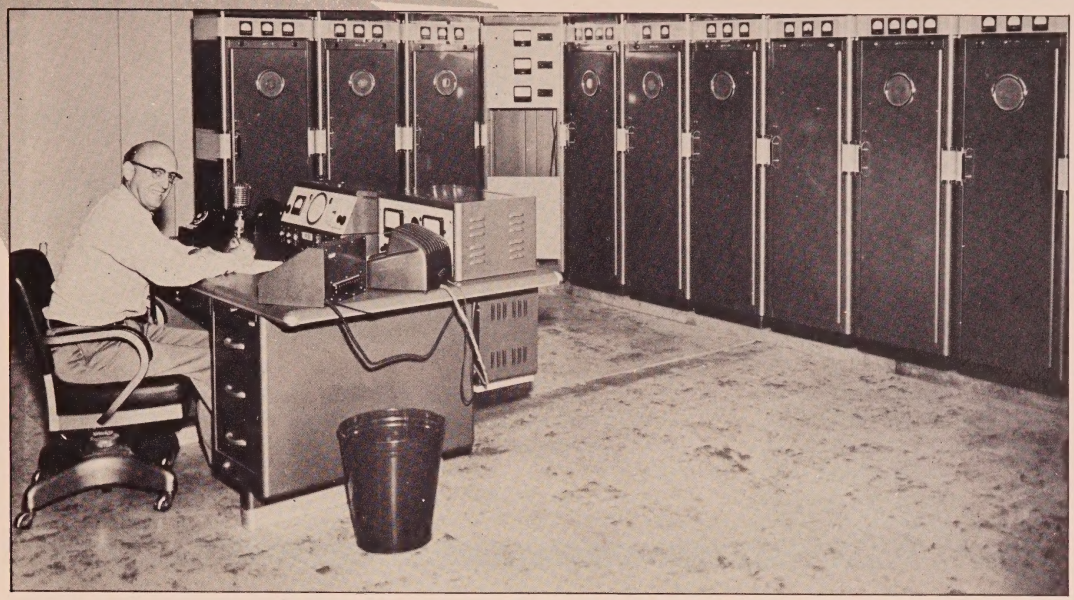
One part of the building serves as a disaster communication center where reports can be received and reviewed by administrative officials responsible for coordinating relief work. Telephone lines are brought in to reduce the radio system load under emergency conditions.

Other sections of the building are devoted to space for the radio operating room, a very complete drive-in service and repair shop, an emergency engine-driven generator and offices for the staff.

For security reasons, all the features of the system cannot be publicized, but the precautions against loss of the local VHF antenna will afford an idea of the thoroughness with which the station was planned. An auxiliary antenna, ready for operation, is installed underground. When it is needed, hydraulic pressure is applied to run the antenna up to a height of 50 feet!

MICROWAVE CONTROL

To cover the 4084 square mile area, three remotely controlled base stations are operated from the central dispatching office. Because of the inherent vulnerabil-



Stephen D. Sykes, county police department radio engineer, at the dispatcher's console in the central station. The cabinets in the background house the microwave and VHF units.

ity of wire lines, the three remote stations are controlled over separate Motorola microwave spans. The three microwave spans are identical, each having two outgoing channels and five incoming channels as viewed from the headquarters station.

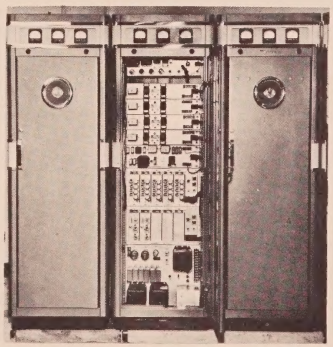
One outgoing channel carries the voice signal to be transmitted by the remote VHF transmitter and a control signal to turn the transmitter on and off. The other carries audio frequency pulses through which the squelch circuit of the remote VHF receiver is controlled.

Of the five incoming channels, three carry the outputs of the three remote FM receivers, another carries the output of an AM receiver and the last carries a telemetering signal. One of the FM receivers is tuned to the patrol car transmitter frequency; a second is tuned to the frequency of the transmitters installed in special vehicles; and the third is tuned to the frequency of the emergency transmitter carried in all vehicles. The AM receiver is tuned to the communication reserve organization frequency. The telemeter signal permits the local operator to observe the power output of the remote transmitter. One of the FM receiver channels also carries an alarm signal to announce the approach of a trespasser at the remote station to the headquarters staff.

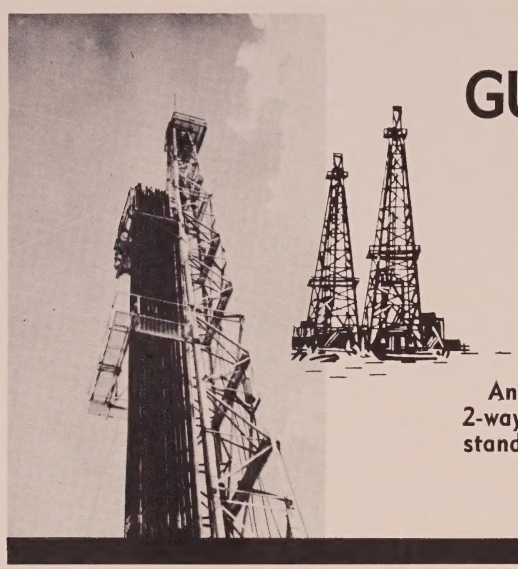
MOBILE CENTER

If it should become necessary to abandon or supplement the control center, the department has an emergency mobile communication center ready for immediate operation. The unit contains a 250 watt base station, the required receivers, conference space, sleeping quarters, cooking facilities and provisions sufficient for 30 days. Two 3-kw. power generators provide all the power needed. The 30 foot antenna is broken into sections and carried inside the trailer when it is in motion.

The tremendous effort the County of Los Angeles has taken to insure survival of its communications system through any conceivable disaster is indicative of the importance 2-way radio has assumed in police work over the past two decades. The citizens of the county are assured swift, sure police protection through any emergency. The system is a tribute to a group of law enforcement officers determined to do their job well.



Each of these cabinets contains the multiplex chassis for one microwave circuit.



GUSHERS COST BEFORE THEY PAY

And when shutdown time costs $1000 a day, 2-way radio pays big dividends even by oil field standards.

Since 1944 the Rotary Engineering Company of Midland, Texas, has offered a logging service to the drillers of exploratory oil wells in the Permian Basin. As part of the service, Rotary graphically records such factors as drilling rate, oil and gas content of formation samples and visible porosity through 24 hours a day. The company also analyzes the well core and provides lithology plots of formation samples. The sole purpose of all these operations is to eliminate the possibility of drilling past a potentially productive oil or gas zone.

To provide this service one of more than thirty 3 man engineering teams is assigned to each well site. These men work in shifts around the clock out of a mobile office-laboratory equipped with the latest test instruments available.

HOURS SAVED

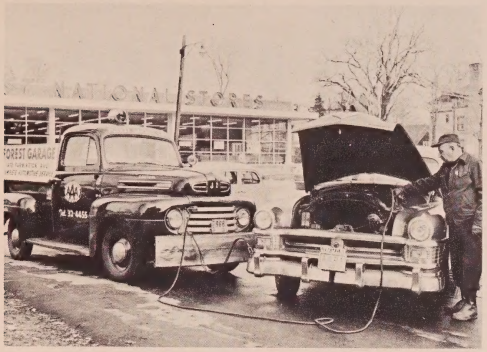
Quite frequently, a formation is encountered which requires testing in the hole to determine whether or not it is oil-bearing. To conduct the test, the complete drill pipe must be removed before the test equipment can be lowered to the bottom of the hole. When such a condition occurs, all the available data is normally referred to the office in Midland for a decision before the pipe is removed. Since most of the exploratory wells are sunk in remote areas, sometimes two or three hours by car from the nearest telephone, interim shutdown time might very well mount up, and as a matter of fact it did mount up before Rotary installed its 2-way radio system in 1951. Because shutdown time on a drilling operation costs an average of $1000 a day, the Rotary trailer is just that much more welcome at a drilling site since it has been radio equipped.

Rotary's three base stations, spotted at strategic points in the Basin, are controlled by radio from the Midland office to cover most of the area of operations. Mobile 2-way radio units are installed in all the equipment trailers at the well sites and in most of the other Rotary vehicles. When a hole is sunk outside the range of the three base stations, messages are relayed manually by other Rotary mobile units in trailers at intermediate locations.

OTHER USES

Primarily, the radio system is set up to expedite the service provided by Rotary and this one application justifies its use. However, there are many secondary applications which multiply its value. When an emergency occurs at the well, assistance is obtained in half the time that was formerly required. When the drill hits water, cementing equipment can be dispatched from Midland in a matter of minutes. In case of serious injury, only a quick radio call is required to summon a doctor or an ambulance; the time saved could easily mean the difference between life and death. When the drilling equipment breaks down, replacement parts are obtained in a fraction of the time otherwise needed.

In the drilling field, where emergencies are common and time is valuable, 2-way radio is in its element.



Auto Club
STREAMLINES SERVICE CALLS

Stranded motorists who call the Automobile Club of Hartford, Conn., go speeding on their way faster these days, thanks to Motorola two-way radio.

The AAA-affiliated club, faced with a rapidly increasing membership that makes more than 10,000 calls for road service each year, turned to two-way UHF radio early in 1953. Results have been excellent, say club officials.

Spot checks show that many calls for help are received, dispatched and completed in only six minutes' time. Each of the six radio-equipped trucks has more than doubled the number of calls handled, and the club has been able to reduce the number of its contract garages and still increase the speed and efficiency of its service, says General Manager W. G. Robinson.

During days, dispatching is done in a soundproof booth in Auto Club headquarters. Dispatchers taking calls for help have before them spotting and control maps of the area, as well as control boxes for the mobile units. The night dispatcher has a remote control consolette in his apartment, giving motorists round-the-clock emergency service. The base station, operating in the 450 mc. band, feeds signals to an antenna mounted on a tower atop the Auto Club office.

In the field three key garages with radio-equipped trucks are on 24-hour call. Each driver reports by radio to club headquarters when he leaves on a call, and again when the motorist is sent on his way.

The club also maintains two-way radio contact with the general manager's sedan, frequently used as a patrol car. The auto and trucks several times have won favorable publicity for the Auto Club by quickly calling for the police, fire department and ambulances, via radio.

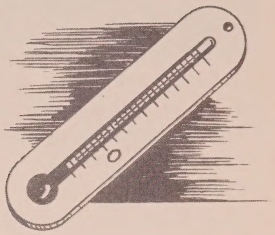
Hartford may find yet another good use for the Auto Club's radio system. The facilities have been offered to Civilian Defense officials for use in emergencies. The offer was gratefully accepted by CD Director Henry Thomas, who predicted the radio system could be extremely valuable in any circumstances where telephone lines were disrupted and mobile units could bridge the gaps.

After office hours, the night dispatcher handles service calls over this remote control consolette in his apartment.

Mechanic Joe Stiefel confirms address of a distress call before leaving from one of the Club's contract garages.

SUB-ZERO

MOUNT RAINIER SKI PARTY REPORTS TO PARK RANGERS BY 2-WAY RADIO—



Skiers Ira Spring and John Carter pass an ice-covered sign on the way to the base camp.

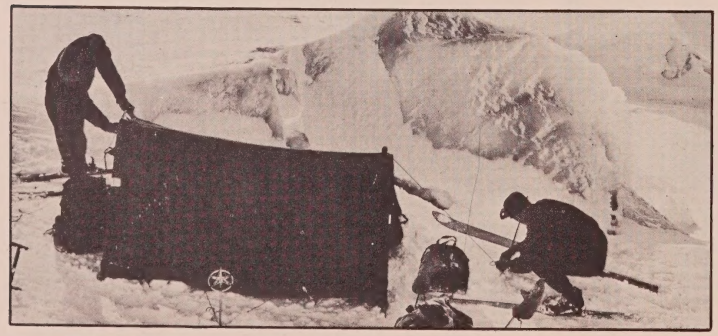
Soup for lunch—but first the cook has to melt his snow.

When four Seattle mountaineers climbed to a remote cabin high up on Mount Rainier to test winter garments, they wanted their communications to be foolproof. And because every pound in a skier's back-pack has to be worth its weight in muscle, the talkpower they chose was a Motorola "Handie-Talkie" unit—10 pounds of rugged dependability. The radio, tuned to the National Park frequency, kept park rangers informed of the party's welfare daily.

Purpose of the expedition was to determine how effective several types of sleeping bags and insulated garments were in sub-zero temperatures. In preparation, several hundred pounds of equipment and food had been hauled to the cabin during the summer before the snows came. The actual tests took place 10,000 feet up the mountainside in a cabin with three-foot-thick rock and concrete walls.

In the party were Charles Doan, a University of Washington student; John Carter, a music teacher; and Bob and Ira Spring, photographers.

Snowstorms and high winds plagued the climbers from the time they left their auto at 4,500 feet and set out on skis to cover the last five miles. The storm raged seven days, shaking the cabin walls and piling snowdrifts high against the door—so high, in fact, that a 20-foot tunnel was dug to reach the outside. It was in this tunnel that sleeping bags were tested.



The mountaineers set up an Army experimental tent on Nisqually Glacier, but severe storms forced them to spend most nights in their cabin.

When the weather finally cleared, a camp was established on the Nisqually Glacier. From

On the homeward trip, skis were lashed together into a toboggan to transport the tested gear.

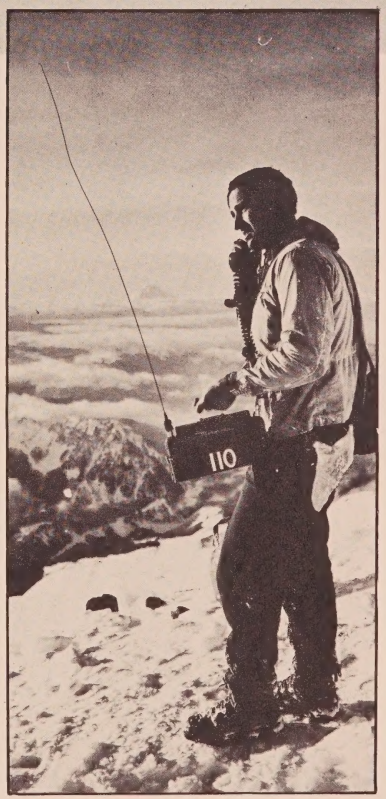
here the group roped together and explored the interesting formations around them. The bottoms of the gaping crevasses found on the summer trips had mostly been filled with snow, making it possible to ski under towering ice cliffs or around ice seracs. Never had the glacier been more beautiful.

Several thundering avalanches roared off the cliffs above the glacier, and although the climbers were careful to stay away from danger areas, twice they were engulfed in the clouds of snow that blew out from the avalanches. The glacier camp was abandoned after two days when another storm closed in around the skiers. This storm was as violent, if not worse, than the first.

During the trip down, the "Handie-Talkie" unit forestalled a ranger search when unexpected icing delayed the skiers. A few thousand feet below the cabin, the mountaineers encountered a glare ice crust covering snow and rock alike. The crust was so thick that the climbers were unable to get a foothold, and it was necessary to lower themselves and the toboggan with the aid of ice axes and climbing ropes.

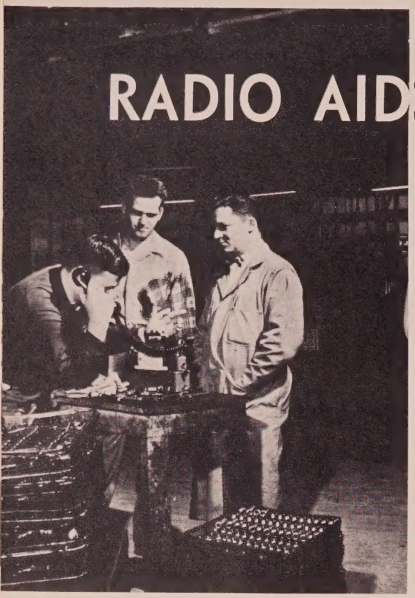
The 2,000 feet of descent across this icy stretch normally would have been done in half an hour, but under these hazardous conditions it took the party six hours. When night came, the climbers were still at 7,000 feet elevation and at the edge of icy cliffs. Rather than risk a misstep in the dark, the quartet reluctantly decided to bivouac at that level and continue their descent in the morning. When camp was set up, the situation was reported to rangers in time to forestall a search party setting out.

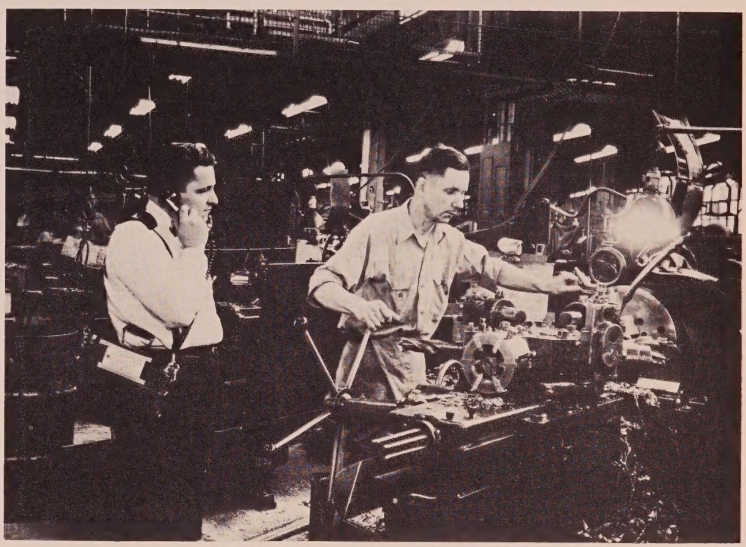
At other times the skiers used the radio within the thick-walled cabin and 100 feet down in the bottom of a crevasse. Results were excellent. As Ira Spring remarked afterward: "The 'Handie-Talkie' unit proved to be a wonderful aid to mountaineering. It has a good range, is very light, and even survives spills on skis."



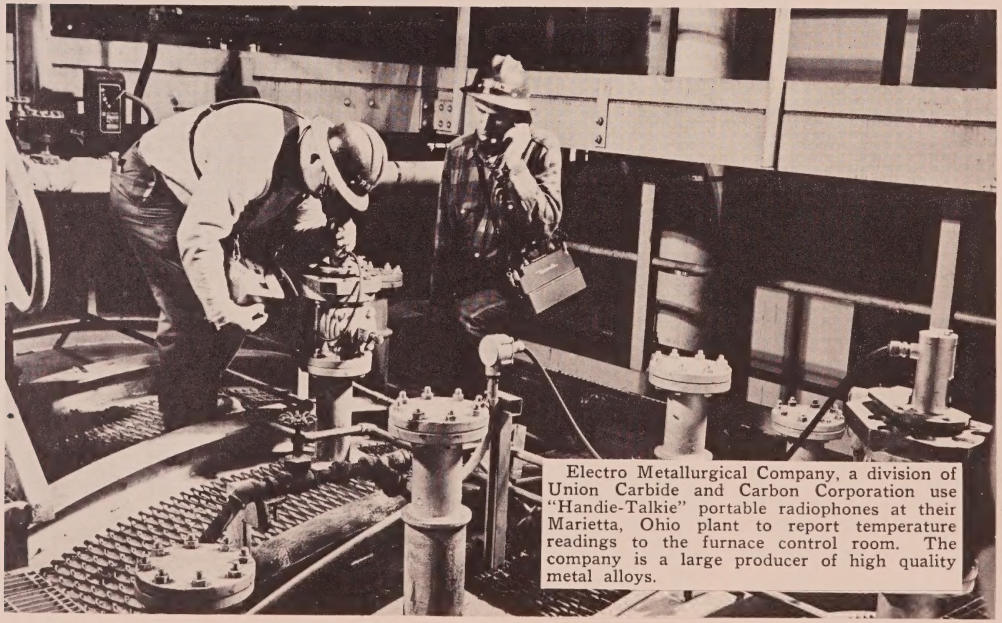
Ira Spring talked daily with Park Rangers 10 miles away, reporting on the party's progress. The "Handie-Talkie" unit's antenna was accidentally bent when a skier took a fall.

RADIO AIDS INDUSTRIAL OPERATIONS





Above and right: The Weatherhead Company of Cleveland, Ohio uses two-way radio instead of paperwork to speed production. Roving "reporters" in the plant report job progress via radio to the company's control room. Expediting is instantaneous with radio ties to materials handling vehicles.



Electro Metallurgical Company, a division of Union Carbide and Carbon Corporation use "Handie-Talkie" portable radiophones at their Marietta, Ohio plant to report temperature readings to the furnace control room. The company is a large producer of high quality metal alloys.

MOTOROLA IN MOVIELAND

Yes, even Hollywood depends on Motorola two-way radio systems—not only for rapid communications out on location, however. In an effort to be authentic, Hollywood producers have turned to Motorola to provide the props that add realism to their stage settings. In the film strip at the right are shown scenes from some of the late movieland productions.

An Allied Artists Production "Riot in Cell Block 11" starring Neville Brand and Emile Meyer.

An Allied Artists Production "Riot in Cell Block 11" starring Neville Brand and Emile Meyer.

A Republic Studios Production "Tobor" starring Charles Drake and Karin Booth.

A Mercury-International Production "Don Barrage" starring Jimmy Layden.

Nick Lindt, left, and Bob Hope pose for the cameraman at the Bing Crosby Open Golf Tournament at the Pebble Beach Country Club in Monterey, California. Lindt reported scores to the press, radio and spectators from his strategic spot at the ninth hole on the famous Pebble Beach course.

CITIES

Miami has now extended its eyes to the air. The Goodyear blimp "Ranger" based in the city during winters, has been equipped with Motorola two-way radio to aid Miami's law enforcement agencies. If a boat becomes stranded in Biscayne Bay or a child lost in the palmetto thickets, the "Ranger" can serve as a spotter to guide rescuers. Shown at the left inspecting equipment are (left to right): Captain V. L. Smith of the "Ranger"; Ben Denby, supt. of communications for Miami; E. A. Evans, Miami city manager; and Col. Edwin L. White, chief of the FCC's Safety and Special Radio Services Bureau.

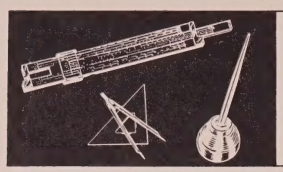
E. Lee Simon, director of civil defense for the city of Rock Island, Illinois is shown at the left checking over civil defense communications equipment available in case of disaster. Portable "Handie-Talkie" pack units provide versatility needed in emergency.

PREPARE FOR DISASTER . . .

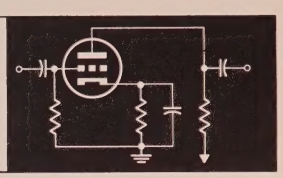
• • • • All over the nation, cities are taking positive steps to prepare for the safety of their citizens in the event of disaster. They are preparing for floods, fires, tornadoes and earthquakes as well as for an atomic attack. And in every case direct, constantly available communications is one of the most important elements in the security planning. These cities realize the virtue of readiness—that those who are to provide communications must be thoroughly trained before a disaster occurs. They know that communications systems *operated by habit* are the only ones that are useful in an emergency.

Toledo, Ohio recently carried its story of progress—communications today and 100 years ago—to TV viewers in the city. In the top picture (left to right) Fire Chief Arnold Papenhagen and William H. Kirk, safety director, explain the changes in fire fighting techniques to John Saunders of the WSPD-TV staff. In the lower picture, Chief Papenhagen demonstrates the old and new.

Trying out a new "Handie-Talkie" portable radiophone is Lloyd A. Shellabarger (left), assistant director of Oakland, California Civil Defense and Disaster Council. With him is Police Lieutenant George T. Self.

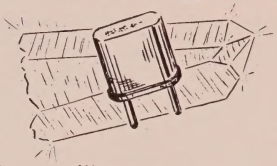


Technical Notes Section



CRYSTAL TESTING TECHNIQUES

By W. E. Kemper, Quality Control Engineer, Motorola, Inc.



Crystal problems are not always what they seem—a new crystal may not be the answer.

It is simple for a technician to remove a crystal suspected of being defective and return it to the factory for replacement. However, in recent months, over one-third of all crystal returns, when tested in the laboratory, have met strict factory test specifications. These crystals are actually *better* than new crystals because they are "broken-in" and the possibility of early-life failure is eliminated. The following procedure will be of assistance in ascertaining which crystals are more precious than new crystals and should be retained in use.

DISCRIMINATOR

The frequency relationships in any communications receiver are inseparably tied to "discriminator zero". Thus, the first step in a crystal check is alignment of the discriminator to zero with an external 455 kc. signal source. A 455 kc. crystal in the Motorola P-8501-A Portable Test Set will produce the desired signal to be fed into the 1st stage in the 2nd IF section. Align the discriminator secondary for a zero reading in meter position 4.

Now switch the test meter to position 6 (1st oscillator) and adjust the 1st oscillator warping coil for a peak reading. Typical peak readings are listed in some instruction manuals. There will be variations between the different models and different versions of the same model. If the correct value for a peak reading is not known, the average of several readings of identical receivers may be used.

RF SIGNAL

The second step in the crystal check is to supply a signal from a transmitter on the correct frequency (preferably the base station transmitter). It is essential that the transmitter frequency be known to be correct: an off-frequency transmitter can produce symptoms of receiver crystal problems.

ACTIVITY

Tune the receiver 1st oscillator circuit to produce a zero discriminator meter reading (position 4). Check the "on-frequency" crystal activity by switching to position 6 and checking the new value. This meter reading (position 6) should be at least 12 microamperes *but* should also be 10% or more below the peak meter reading for D07, D15 and early D01 crystal oscillators. If the crystal activity is outside these limits with an "on-channel" signal, it can be concluded that the crystal is defective *if* the peak activity is normal. In some cases the oscillator circuit components may have aged to a point where even a new crystal will appear defective because the tube is low in gain or perhaps because the metering resistor or plate resistor has changed value. Substitution of a new tube and measurement of resistance with a calibrated ohmmeter will aid in discovering these conditions.

An easier method, however, is substitution of a good crystal from another receiver of the same model. If the crystal known to be good does not perform properly, the oscillator circuit is probably at fault. Conversely, if the crystal is suspected, try it in other receivers before convicting it.

The maximum limitation (at least 10% below peak) does not apply to oscillators using D21 crystals, to oscillators manufactured after January 1, 1953 which use D01 crystals or to D01 oscillators modified in accordance with bulletin SRN-81. These oscillators have been designed to operate at, or on either side of peak activity.

The minimum limitation (12 microamperes) is suggested to protect receiver sensitivity. In some cases the activity can fall as low as 8 or 9 microamperes

before the injection voltage drops sufficiently to cause a discernible loss of sensitivity, but, in general, activity below 12 microamperes indicates that something is wrong if everything else is normal. One exception to this minimum is the 25-50 mc. Sensicon two-frequency receiver utilizing a 12AU7 oscillator tube. In this case, 5 microampere activity is normal.

TUNING SLUG

In the D07, D15 and early D01 oscillators, the tuning tool should turn in a *counterclockwise* direction when moved from "peak activity" position to "on-frequency" position if tuned from *under* the chassis (*clockwise* from the *top* of the chassis). This withdraws the tuning slug, decreasing the warping coil inductance, raising the oscillator frequency. Moving the slug in the opposite direction (lowering oscillator frequency) places the crystal in a region of unstable activity. In this region, after any interruption of plate voltage, such as a transmission, the oscillator may fail to start again. This condition is present *only* on one side of peak activity of the D07, D15 and early D01 oscillators.

The later D01 circuits (used since approximately January 1, 1953) of Sensicon receivers and the D21 circuits of Uni-Channel receivers (in production since November, 1951) are not critical and tune to frequency at, or on either side of, peak activity.

A word of warning: the D21 and D15 crystals are *not* interchangeable. Each type is designed for and correlated to its own circuitry and cannot be expected to produce the same performance in another circuit.

None of the previous discussion applies to 25-50 mc. receivers. The oscillators of these receivers tune on frequency at approximately 10% below peak activity by turning the tuning tool in a *clockwise* direction from *underneath* the chassis.

COMPENSATORS

If a "compensator" crystal has been installed in the 2nd oscillator to keep an "off-frequency" 1st oscillator crystal in operation, it must be removed and replaced with a standard frequency 2nd oscillator crystal if a new 1st oscillator crystal is installed. The compensator crystal could force the new 1st oscillator crystal to operate on the unstable side of peak activity.

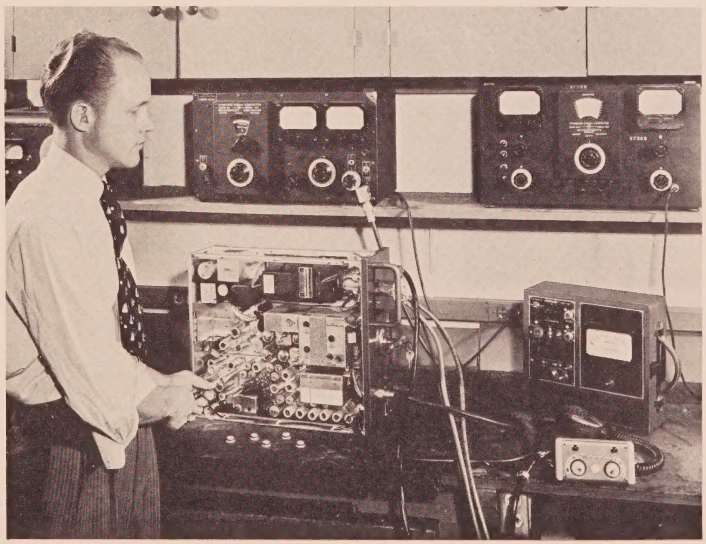
TRANSMITTER CRYSTALS

Transmitter oscillator circuits are usually tuned by using a variable capacitance rather than a variable inductance. The 10 mmf fixed ceramic capacitor across the variable capacitor may be removed, if necessary, to provide an increased warping range. This will allow a crystal low in frequency to be put "on-channel". Be sure to save this capacitor since it is a special temperature compensating device which must be reconnected when a new crystal is installed.

In several instances, supposedly defective transmitter crystals have been found in excellent condition, the real reason for trouble being a partially shorted variable capacitor. An accumulation of dust, metal particles or miscellaneous debris between the closely spaced plates of the capacitor can simulate a crystal problem. Be sure the capacitor is kept clean.

SUMMARY

If the above procedures are observed and crystals are carefully checked before the decision is made to return them, it is obvious that a saving in time, money and inconvenience can be realized.



Make sure you need a new crystal before replacing it.

SERVICE HINTS and SHOP NOTES

MUTING

From MSS operator Edward Schaper of Clayton, Missouri, comes a suggestion on application of the K-8638 Squelch Relay for segregating incoming signals on two radio channels. In the specific example, a remotely controlled base station monitors traffic from police mobile units with one receiver, and point-to-point police messages on a second receiver. When the second (point-to-point) receiver is not muted, its audio signal is mixed with that of the mobile receiver on the control line, perhaps causing the dispatcher to miss a portion of the transmission. When the second receiver is muted, the dispatcher may forget to unmute it, thus missing point-to-point messages.

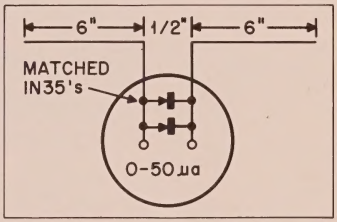
Human error and message interference is eliminated by using the K-8638 Squelch Relay connected to the mobile frequency receiver. The squelch relay mutes the point-to-point receiver automatically when a mobile message is being received and automatically unmutes the point-to-point receiver when the transmission is completed. Thus, the mobile messages are given priority but point-to-point channel monitoring is maintained when no mobile channel messages are being received.

FIELD STRENGTH-450 MC.

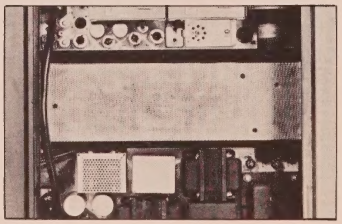
Gene Arnold, radioman for the Timken Roller Bearing Company of Canton, Ohio, has devised a 450 mc. field strength meter easily constructed at minimum cost.

Two #14 wires are brought out from the terminals of a 0-50 microampere meter and spaced ½" apart. The leads are bent to form a half-wave dipole antenna, each leg of the dipole being 6" long. A pair of matched 1N35 crystal diodes across the meter terminals rectify the RF to produce the meter reading.

Mr. Arnold reports that full scale readings are obtained at approximately 6' from a mobile antenna, minimum readings are obtained at about 100'.



Circuit diagram of 450 mc. field strength meter.



LINE

Alvin Phillips, MSS operator at Ogden, Utah, suggests the following solution to the problem of high hum and noise level on a control line during and following an electrical storm.

Static discharges on open lines sometimes unbalance the line by partially shorting one side of the line to ground through the carbon arrestor. Carbon particles become lodged in the gap and must be cleared to remove the hum. As a temporary measure, the line can be balanced with a high resistance potentiometer.

A 50,000 ohm potentiometer can be connected directly across the line. The center tap of the potentiometer is grounded. By rotating the arm until electrical balance is achieved, the noise and hum can be balanced out until the arrestor can be replaced or repaired.

Caution: where control voltages are applied to the line, the current supplied to the line must be adequate to operate the relays at the remote end of the line even with the potentiometer in use. The potentiometer must be of sufficient wattage rating to withstand the control voltages. This measure is not practical on lines with excessive induced 60 cycle voltage.

Left; TK109 Receiver Shield and Filter Kit (installed) described on the following page.

SHIELDING

In duplex systems, in repeater systems and in similar applications where the transmitter and the receiver are functioning simultaneously, there is bound to be a minute amount of RF leakage from the transmitter into the receiver circuits. In most cases, this leakage is negligible. However, as an added safeguard against interference possibilities, all current Motorola repeaters which include simultaneous transmitter and receiver operation are being shipped with a receiver shield and filter installed. This same kit, the TK109, can be installed in any base station model employing a Sensicon receiver (25-50 mc., 152-174 mc. or 450-470 mc.) where stray RF pickup affects system performance.

The TK109 Receiver Shield and Filter Kit contains a chassis bottom cover plate and a perforated shield to cover the top of the chassis. This reduces the effects of stray RF energy radiated directly to the chassis. For the RF energy coupled through the power and control leads, each input and output lead has an individual double "L" filter, isolating the receiver from cabling pick-up. Filtered leads are also included for the K-8638 Squelch Relay if used.

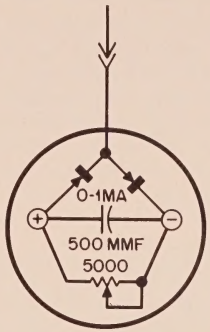
The TK109 finds its main application in repeater systems where a transmitter radiating up to 250 watts RF output operates at the same time that a receiver on another frequency is also in operation in the same cabinet. The receiver antenna lead-in is not filtered: the TK109 is designed to suppress intra-cabinet interference, not interfering radiation which enters the receiver through the antenna.

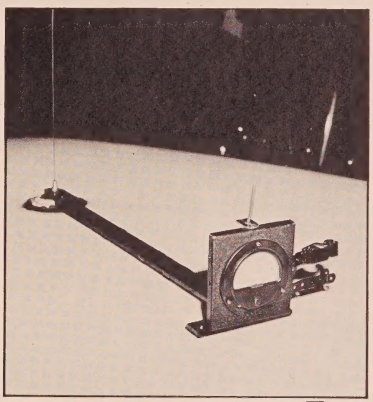
FIELD STRENGTH-160 MC.

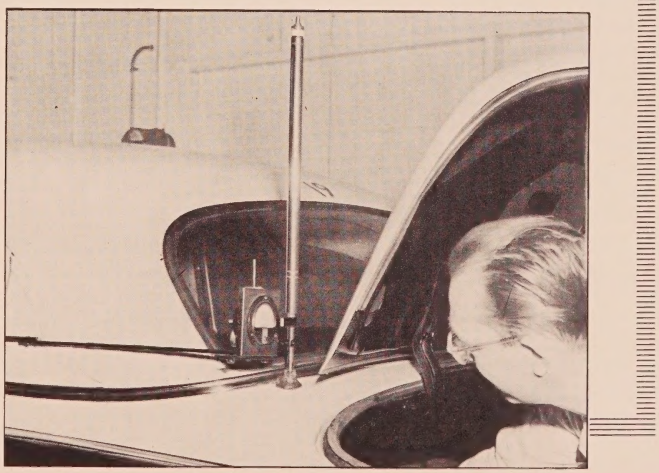
Tracey and Company, Inc., MSS in Portland, Oregon, submits a suggestion for a field strength meter useful in field servicing of 152-174 mc. mobile units. The meter circuit is similar to that used in the Motorola P-8501-A Portable Test Set and includes a 0-1 ma. DC meter, a pair of crystal diodes, a filter capacitor (500 mmf) and a 5000 ohm potentiometer as a sensitivity adjustment as shown in the diagram. The RF energy received by the short probe antenna is rectified by the diodes, filtered by the capacitor and indicated by the meter. Calibration by markings on the glass meter face indicates relative maximum power output from 10 watt, 30 watt and 60 watt transmitters for use in alignment and antenna loading.

A feature of this meter is the spacing bracket on which the meter is mounted. A yardstick or similar bracket has the meter mounted on one end. The other end has a hole which slips over the rooftop antenna to retain constant spacing for consistent meter readings. A large battery clip and a bracket on one side of the meter adapts it for readings from the P-8377 Coaxial Dipole antenna as well.

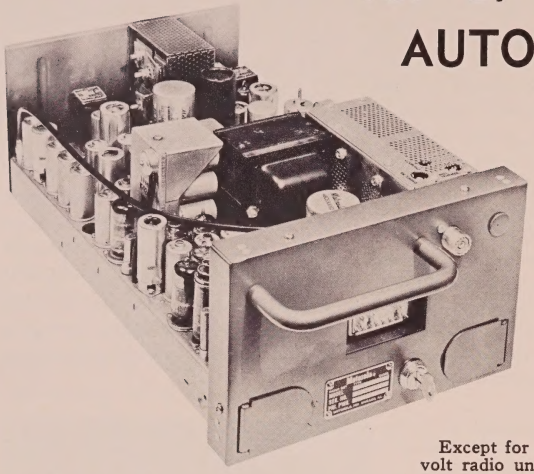
Below, circuit diagram of a 160 mc. field strength meter and two illustrations of its applications.







UNIVERSAL RADIO for 6/12 VOLT AUTO ELECTRICAL SYSTEMS



The last few years have seen a growing number of automobile manufacturers changing from a 6 volt vehicular electrical system to a 12 volt system. This trend initially adapted in the heavier cars will conceivably be extended to include all popularly priced automobiles within the next few years. However, the users of Motorola two-way radio will not be penalized by changing automotive standards in this period of transition.

Except for internal construction, the universal 6/12 volt radio unit resembles a conventional 6 volt unit.

The answer to the 6/12 volt situation has been underway for many years. The first solution, that of design and production of a 12 volt radio unit as a companion to the 6 volt unit, was satisfactory to handle the few 12 volt units required at the time. As 12 volts became more widely used, the design of the 6 volt radio unit was adapted to easy conversion to 12 volt operation, all major components being designed for either type of operation. Then came the vibrator converter unit to provide field expedient adaptation to 6 volt power in 12 volt vehicles for interchangeable use of 6 volt radio sets in all vehicles. And, finally, Motorola designed and produced the universal 6/12 volt radio unit, interchangeable in itself between 6 and 12 volt vehicles.

6/12 VOLTS

The 6/12 volt two-way radio unit power circuit design (exclusively Motorola) is based on a unique series-parallel power supply-filament interconnection (patent applied for). The radio set is completely wired for 6 volt operation and 12 volt operation. The same radio set can be used in either a 6 volt or a 12 volt vehicle without throwing switches, without changing jumper connections, without substituting power supplies and without any radio set modifications. All necessary connections are made from the appropriate power cable.

A 6 volt power cable is installed in every vehicle with a 6 volt electrical system; a 12 volt power cable is used in 12 volt vehicles. The same radio set operates universally and interchangeably from either cable. Thus, one spare mobile unit can be used in any vehicle in the fleet, regardless of whether a 6 or 12 volt battery is used.

At any time that a new vehicle is added to the fleet replacing an older vehicle, the power cable can also be re-installed in the new vehicle. If the battery voltage is different, the simplest of changes adapt the cable to the new voltage. For transition from 6 to 12 volts, one fuse is changed, a resistor is added in series with the "A" relay coil and the power cable plug is rewired. No change of the radio set is required. The total cost of the conversion parts is as low as 85c. Contrast this with the cost of converting a 6 volt radio unit to 12 volt operation—even one which has been specifically designed for ease of conversion.

ADVANTAGES

The 6/12 volt type of operation possesses many distinct advantages in looking toward the future. First, one radio unit serves in all vehicles—there need be no stocking of duplicate spare units and spare parts to accommodate radio sets operating from two voltages. Second, there is no out-of-service time because the wrong type of spare unit was the only one available. Third, there is no conversion parts or labor cost when the radio drawer assembly is shifted from vehicle to vehicle. Fourthly, re-installation in new vehicles is very readily accomplished whether the new vehicle has a 6 or 12 volt electrical system. Fifth, there can be no error in connecting the radio to the wrong source voltage. And, most important, the 6/12 volt fea-

ture does not demand a premium price—its cost is approximately the same as that of a conventional 6 volt unit.

APPLICATION

It is sound practice to insist on 6/12 volt radios for all fleets about to be equipped with two-way radio. Fleets already radio equipped can be expanded with 6/12 volt equipment toward the goal of eventual complete universality. For the older fleets in which the radio equipment has been nearly, or perhaps completely amortized, the savings in service time and greater convenience of universal radio units plus improved performance could easily justify retirement or trade-in of the early models in favor of 6/12 volt models.

MODELS

In the 25-54 mc. range, three series of 6/12 volt models are now available. The T41G (trunk-mount) and D41G (under-dash-mount) series are both 25-30 watt models in 10″ wide housings. The T51G series (trunk-mount) are 50-60 watt models in 15″ wide housings. In the 144-174 mc. range, two series of models are available at present. The T43G (trunk-mount) and D43G (under-dash-mount) series are 20-25 watt models in 10″ housings and the T33G and D33G series are companion 10 watt models. The T44A series in the 450-470 mc. range (including the 460-470 mc. Citizen's Band) include 18-20 watt transmitters and utilize 15″ housings. Additional models will soon be available.

CONVERSION

For those Motorola customers who operate smaller fleets and find less emphasis on the 6/12 volt situation, alternate solutions are available. Parts kits and conversion instructions are available for modifying virtually all previous Motorola 6 volt models to 12 volt operation. This involves filament circuit and relay circuit rewiring and power supply modifications. For vibrator power supplies, the recent units have been designed with most circuit components common to both 6 and 12 volt operation—a few resistors and capacitors are required, however. Dynamotor power supplies require change of the armature, but not necessarily the field because of their conservative design.

CONVERTERS

There are both rotary and vibrator converters on the market which are to be installed in series with the power cable in vehicles with 12 volt electrical systems. Since all radio units then operate from 6 volts, the same radio units are used in all vehicles. This type of solution may be satisfactory for the smaller, more recently equipped fleets. In any case, the converter efficiency and voltage regulation as well as the ease of installation are the important factors to be considered.

The Motorola TA142 Vibrator Converter, for use with models in the FSTR-80 and FSTRU-80 and early T44A series, utilizes a unique circuit, best described as a DC autotransformer with a heavy duty 16 contact vibrator. The conversion efficiency is approximately 80%, minimizing primary power drain. The voltage regulation is better than ½ volt from maximum to minimum load under both transmit and receive conditions.

FEATURES

UNIVERSAL interchangeability between vehicles with 6 or 12 volt electrical systems—any radio set operates from both 6 and 12 volt power cables.

LOW DRAIN achieved through new, efficient power supply circuitry (patent applied for) provides more watts output per ampere input.

NO SWITCHES to throw, no jumpers to move, no components to change when the radio unit is transferred to another vehicle.

ENGINEERED with all of the features of low maintenance, easy servicing and unexcelled performance of all Motorola radio equipment.

SAFE from damage due to connection to the wrong source voltage—all radio units are identical, only the power cable wiring differs.

VERSATILE in changing fleets, a fuse, a resistor and a power cable plug wiring change adapt a 6 volt cable to a 12 volt vehicle.

ANTENNAS

The antenna is the entrance and exit for RF energy in any radio communications system station. It pays to use the proper "doorway".

Whether an antenna is used for transmitting only, for receiving only, or for both, exactly the same considerations are involved in its selection as long as the use is within the antenna power rating. These factors include polarization, mechanical strength, necessary supporting structure, mounting facilities, resistance to wind, ice, and corrosion, radiation pattern and cost.

TYPES

The basic element in virtually all communications antennas is the vertical quarter-wave "whip" radiator. At 30 mc., a quarter-wave "whip" is approximately 8 feet high. At 150 mc., 18 inches, and at 450 mc., 6 inches, are the approximate quarter wavelengths. It becomes apparent that antenna arrays using multiple elements are more easily constructed at the higher frequencies since the size and mechanical strength factors are more easily surmounted.

The simplest antenna is merely a length of wire, one-quarter wavelength long, connected to the inner conductor of the coaxial transmission line. The outer conductor of the line is grounded. A typical example is the Motorola P-8654 antenna used with "Handie-Talkie" portable radiophones or the P-8553 series of automobile rooftop antennas. The basic pattern resembles a doughnut with the "whip" projecting through the hole in the doughnut. This type of antenna transmits or receives maximum energy horizontally: there is virtually no vertical response. However, to achieve this pattern, the antenna must be working against a good ground plane. If used at tower-top, some means must be employed to achieve an artificial ground plane and isolate the antenna from the effects of the metal tower and transmission line. The tower or line will be in the same plane as the radiated or received energy and may act as parasitic antenna elements. The result will be a tendency to bend the radiation pattern upward, wasting the transmitter power and the receiver sensitivity toward the sky.

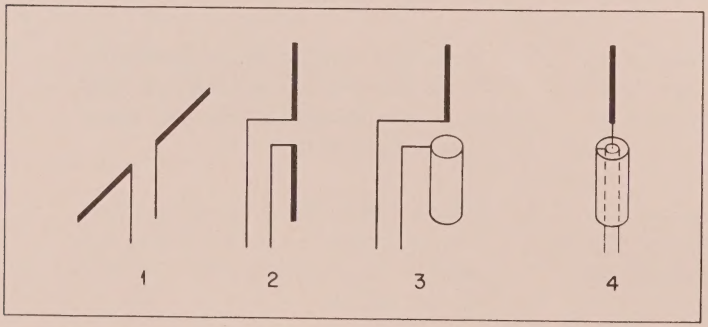
GROUND PLANE

One method of isolating the antenna from the line and tower is the use of ground plane rods. The P-8531 "Isoplane" antenna is based on this principle. At the base of the quarter-wave radiating element, four quarter-wave rods project at an angle slightly below horizontal. The angle is selected to closely restore the original doughnut pattern. Additional isolation is provided by four other horizontal rods lower on the mast.

The "Unipole" type of antenna (Motorola DS-9677 series) is another variation of the ground plane approach. A quarter-wave "hairpin" folded dipole is the radiator, one end of which is grounded. The grounded radiator provides a direct ground for static electrical charges which could add to receiver noise level and also provides lightning protection without the use of arrestors or gaps. Two series of models are available, the "standard" series and the "hurricane" series, the latter specifically designed for maximum resistance to wind, ice, salt spray and corrosive atmospheres.

COAXIAL

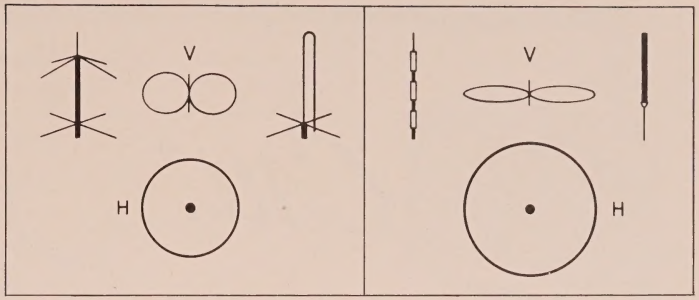
From the horizontal dipole antenna, so commonly used with TV receivers, the coaxial dipole is easily evolved. The radiator is rotated to a vertical position, the lower element is enlarged into a tube, and the feed line is run through the tube to the junction of the two elements. The result is similar to the use of a ground plane. The radiating element is isolated from the interference of parasitic excitation of the tower and line, keeping wasteful high angle radiation at a minimum, providing maximum radiation downward and toward the horizon. The P-8377 Mobile Coaxial



Evolution of the coaxial dipole antenna from the half-wave dipole.

Dipole (152-174 mc.) and the P-8250 Base Station Coaxial Dipole (25-54 mc.) are examples of this type of antenna.

Through the use of additional parasitic "skirts" in the coaxial array, additional isolation is achieved, a broader band of operating frequencies is attained, and directivity is improved. An example of this type of antenna is the P-8350 Triple Skirt Coaxial Antenna (144-174 mc.)



The "Isoplane" and "Unipole" Antennas have omni-directional coverage. Skirted and other multi-element antennas exhibit additional gain.

STACKED ARRAYS

In the 450 mc. band, the diminutive size of the quarter-wave or half-wave antenna readily lends itself to stacked arrays of several radiating elements. For example, the TU114 and TU115 antennas consist of a number of vertically stacked half-wave antennas with physical positioning and phasing leads so designed that an effective gain of 4 db. is realized. The DS-9621, with an even greater number of radiating elements, achieves a 7.2 db. gain, equivalent to multiplying transmitted power or received power by more than 5 times. Since a metallic support for the radiating elements in these antennas would tend to distort the pattern and create additional design problems, the elements themselves are embedded in a nonmetallic cellular core, encased in fiberglass and cast in polyester resin plastic.

DIRECTIONAL ARRAYS

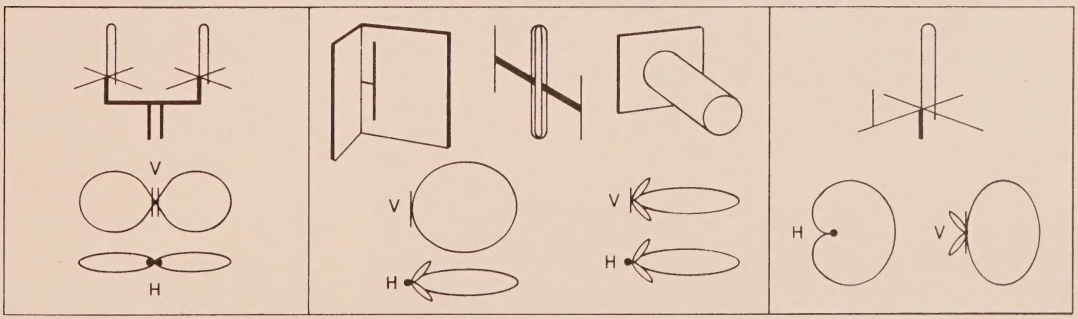
Directivity may be desired in the horizontal plane. For a base station near the edge of the area it covers, a half-circle (180°) pattern is desirable. The "Cardioid" antenna, essentially a "Unipole" antenna with a reflecting element, provides a heart-shaped pattern through use of additive radiation in one direction, cancellation in the other direction.

Communications along a straight-line route such as a pipeline, a highway or a railroad, or in a long, thin geographical area can employ the DS-9600 bi-directional antenna with radiation primarily in two opposite directions. This structure is composed essentially of two "Unipole" antennas positioned and fed to produce the desired pattern.

For point-to-point coverage only, a highly directional array such as the corner reflector antenna (DS-9687, 152-174 mc.) or the yagi antenna (DS-9653, 152-174 mc.) concentrates the radio energy into a narrow beam (effectively high gain) making low powered transmitters applicable for reliable point-to-point communications.

HELIX

A recent addition to the directional antenna group is the DS-9602 series with a helical radiating element. The beam is very narrow and circularly polarized. While a horizontally or vertically polarized antenna will receive a portion of the circularly polarized energy, maximum gain is achieved by using another helix antenna at the opposite end of the transmission path. For discrimination against signals arriving at two antennas close to each other in both spacing and frequency, clockwise and counter-clockwise circular polarization can be used to great advantage.



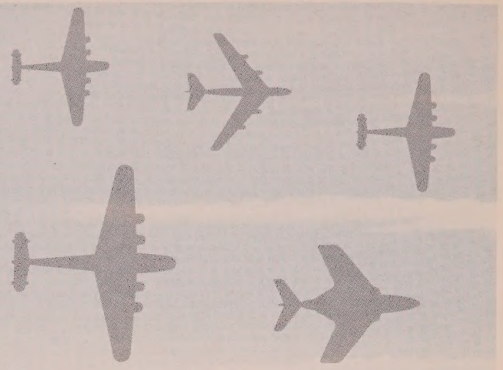
Bi-directional antennas provide two direction coverage, corner reflector, yagi and helix antennas provide beamed unidirectional coverage and "Cardioid" antennas provide broad unidirectional coverage.

airborne

"QUIK-CALL"

for

SELCAL • Aircraft Selective Calling Systems



SELCAL is a name derived from the words SELective CALling and applied, by the commercial airlines, to a system whereby a ground station can actuate an indicator in the cockpit of any individual SELCAL equipped aircraft via the existing radio channel. Motorola QUIK-CALL, a veteran of seven years of selective signaling in the land-mobile services, was a natural choice to become airborne. All of the latest engineering improvements plus several special adaptions have been incorporated to perfect airborne QUIK-CALL. Cooperation between Motorola and Pan American World Airways engineers has produced equipment now in use in the PAA Pacific-Alaska Division.

WHY

It is a well known fact that every extra ounce carried, every cubic inch used and every device which tends to increase complexity in commercial aircraft must be justified. When closely analyzed, airborne QUIK-CALL more than pays its own fare.

The captain of the aircraft is responsible not only for manipulating controls, navigating the plane to its destination safely, but is also responsible for many related activities. There are meters, gauges and indicators to read and interpret. There are orders to give to coordinate activities in directing the flight. There are radio navigation signals to follow, and, last but not least, radio communications channels to monitor.

Under CAVU (Ceiling And Visibility Unlimited) conditions, it could be expected that the captain would have little difficulty in performing all of these functions fully satisfactorily. However, tests have disclosed that continuous monitoring of noise and extraneous message traffic on a radio channel tends to affect both physical and mental performance. As time elapses in monitoring, there is a gradual decrease in hearing acuity and degradation of psychomotor efficiency. This condition has been termed "pilot fatigue". CODAN (Carrier Operated Device, Anti-Noise) squelch, minimizing nuisance noise at the speaker or headphones, has reduced this problem but is not the complete answer.

Under more unfavorable weather conditions, the captain's attention may be centered on the more pressing matters of piloting the aircraft, thus slighting the attention due the radio receiver. If radio monitoring is continued, the distraction caused by noise and extraneous messages reduces his capacity to devote full attention to other duties.

QUIK-CALL can maintain a listening watch automatically to relieve the captain of this duty without interfering with regular communications in any way.

HOW

QUIK-CALL equipment consists of two system components. An audio tone code generating component connects into the audio input circuits of the ground station communications transmitter in parallel with the microphone. A tone decoder in the aircraft connects into the airborne communications receiver. A tone code transmitted by the ground station is received by all airborne receivers. However, only the tone decoder responsive to the individual code transmitted is actuated. The actuated tone decoder, in turn, actuates the signaling device, a bell, a buzzer, or a lamp, which is being used in the specific installation. At both the ground station and in the aircraft, QUIK-CALL is an "add-to" item which does not interfere with operation of the radio system when used on a non-SELCAL basis.

GROUND STATION

The ground station installation consists of two parts, the selector and the tone equipment. The selector consists of one or more modules, each module containing

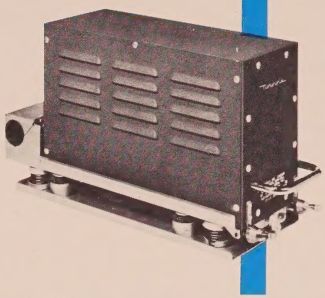
individual selector switches for the four tones used in each code. A momentary push-button switch is the actuating key. The indicator lamp serves a dual purpose, first it is illuminated while the code circuits are in operation and second, its frosted glass face is a convenient place to write the flight or plane number for rapid identification of pre-set codes. The number of modules used for any installation is determined by system requirements. Any number can be used in parallel depending upon how many routine codes are to be set up and the relative convenience obtained by pre-setting codes rather than selecting them just before each transmission. The complete selector assembly can be rack mounted, panel mounted or cabinet mounted for any type of installation in any location. A meter and test panel module is generally included for test and adjustment.

The rack mounted tone equipment occupies 10 rack units of standard 19" rack space. The selector and the tone equipment may be separated by any reasonable distance—up to several thousand feet if necessary. The tone equipment consists of a remote control chassis which interprets the selector switch settings, a tone generator chassis which includes 12 Vibrasender tuning fork type tone generators for producing a like number of discrete tone frequencies in the 300-1000 cycle range, and a power supply and timer chassis which supplies the power to the tone generators and produces the coded signals selected. Each tone code consists of two pulses of two tones each, the individual pulses being of approximately one second duration and separated by approximately .2 second. Each tone is designated by a letter from A to M thus each code is identified by four letters, for example AC-BD. Over 1400 useable tone combinations can be obtained.

AIRBORNE

The airborne tone decoder is available in both single channel and dual channel version, both in identical housings, both CAA Type Certified. The single channel version effectively monitors an individual radio channel for its call code, the dual channel version monitors two radio channels for its call codes on each or can be used to monitor a single channel for two classifications of calls (e. g. routine or emergency).

The decoder is connected to the audio detector stage of the receiver, by-passing the squelch and audio amplifier stages. A limiting amplifier in the decoder compensates for the wide amplitude variations encountered in AM receivers and provides the power to operate the four Vibrasponder resonant reed relays. When the correct tone code is received, the first pulse of two tones actuates two of the Vibrasponders "unlocking the gate" for the second pulse which actuates the second pair of Vibrasponders. Decoder relay contacts then operate to provide the switching required to operate a bell, buzzer or lamp. An auxiliary relay is provided which oscillates at approximately one cycle per second for interrupted signaling. The alarm continues to function until reset, either by a manual push-button reset or by operating the transmitter push-to-talk circuit.



Airborne QUIK-CALL decoders are compact, shock mounted units readily installed in any aircraft.

The ground station includes a conveniently located selector as shown in this Pan American World Airways installation.

TRANSMISSIONS

. . . . On Communications Topics

Backstage

When Actor John Wayne went scouting for a rough-country location in Mexico to film Wayne-Fellows' movie "Hondo" last summer, he had no road maps to guide him.

No roads.

So he took to the air with Director John Farrow, Cameraman Robert Burke and a Motorola "Handie-Talkie" pack set to get the "big picture" of the rough country around Carmargo, Chihuahua. When they spotted an area that seemed to suit their scenario, they directed a carload of assistant scouts, also equipped with a pack set, across the roadless terrain to take a "close-up" look at the section in question.

Burke, Farrow and Wayne

First Class Mail Dept.

From W. N. Broman, Radio Supervisor, Texas Department of Public Safety, we hear:

" . . . . we received for test purposes . . . a laboratory model of your new T51G Mobile Unit . . . . The set was measured on our bench before installation and the transmitter had an output of 46 to 54 watts . . . . depending on battery conditions. The set was installed in a Highway Patrol car during some of the hottest weather, the temperature being as high as 107 in the shade. The unit was in daily service from the middle of July to November 2nd. At no time have any repairs been made. Upon removal from the car, a rapid bench check was made and the power output was 50 watts. The receiver is excellent and in my opinion based upon experience, the type T51G is equal to or superior in every respect to the earlier type FMTR-140D with the added feature of quick change from 6 to 12 volts.

To date we have installed approximately thirty production models of the T51G. The power output averages 50 watts or more . . . . "

Thank you, Mr. Broman.

REGIONAL DIRECTORY

For your convenience, there is listed below a complete directory of Regional Managers for Motorola Communications and Electronics, Inc. together with their offices and territories covered.

REGION 1
HENRY C. GAMMELL
Arizona, California, Idaho, Montana, Nevada, Oregon, Washington, Wyoming, Utah.
Office: 811 South "B" Street
San Mateo, California
Phone: DIAMOND 4-6386

REGION 2
EUGENE F. BROWN
Colorado, Iowa, Kansas, Minnesota, Nebraska, North Dakota, South Dakota.
Office: 817 Kilpatrick Bldg.
Omaha, Nebraska
Phone: WEBSTER 0017

REGION 3
HOMER L. MARRS
Illinois, Indiana, Missouri, Wisconsin.
Office: 1327 W. Washington Blvd.
Chicago, Illinois
Phone: TAYLOR 9-2200

REGION 4
GLENN MUNRO
Kentucky, Michigan, Ohio, Tennessee.
Office: 19142 James Couzens Hwy.
Detroit 35, Michigan
Phone: UNIVERSITY 3-6464

REGION 5
EDWARD L. FALLS, JR.
Arkansas, Louisiana, New Mexico, Oklahoma, Texas.
Office: 171 Parkhouse Street
Dallas 7, Texas
Phone: STERLING 4951

REGION 6
HORACE E. BOYLAN
Alabama, Florida, Georgia, Mississippi, South Carolina.
Office: Stallings Bldg., Rm. 601
1829 First Ave., North
Birmingham, Alabama
Phone: 4-4582

REGION 7
JOHN F. FUSSELL
Delaware, Maryland, North Carolina, Virginia, Washington, D.C., West Virginia.
Office: 2309 Calvert St., N.W.
Washington 8, D. C.
Phone: ADAMS 4-5620

REGION 8
P. R. KENDALL
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont.
Office: 540 Main Street
Winchester, Mass.
Phone: 6-2482

REGION 9
LOWELL E. WHITE
New Jersey, New York, Pennsylvania.
Office: 102 Linwood Plaza
Fort Lee, New Jersey
Phone: 8-9100

REGION 11
FRANK W. WALKER
Arizona, Southern California, Southern Nevada.
Office: 6555 Sunset Blvd.
Hollywood 28, California
Phone: HOLLYWOOD 2-1378

WASHINGTON D. C. OFFICE
L. HARRISS ROBINSON
Federal Agencies

NATIONAL RAILROAD SALES
R. FLOYD McCALL
Office: 4501 Augusta Blvd.
Chicago 51, Illinois
Phone: SPAULDING 2-6500

Jack Bolt looks over innovation that paid off in $2,500.00 award.

MOTOROLAN'S IDEA PAYS OFF

Employees' suggestions have real cash value at Motorola, with the benefits shared alike by the company, employee and customers.

All suggestions are studied carefully, and if the innovation results in a saving, Motorola pays a cash award equal to 20% of the first year's saving.

Jack Bolt, a methods engineer in the Communications & Electronics Division, received an award of $2,500 for his suggestion of an improved method of winding oscillator coils.

Bolt worked out a new gear combination that makes it possible to pile up 1,300 turns of unserved wire on a coil without slippage. Previously it had been necessary to use wire wrapped with fine strands of nylon, at about three times the cost.

Thus by adopting an employee's suggestion, production costs can be slashed and the savings passed on to the public. And the employee is encouraged to turn his ideas into cash.

During the four years Bolt worked in production, he received a total of $4,461 for his suggestions.

MOTOROLA'S "BIG BEN"

Motorola became a leading light in Chicago's skies recently when the world's largest illuminated display sign was lighted on Outer Drive at Randolph Street.

The huge sign advises "Better See Motorola TV" to an estimated 560,000 persons who pass the site daily. Multi-color sequences also advertise 2-Way, home and auto radio, electronics and television in 10 flashing stages.

LARGEST CLOCK

A major feature of the new display—which stands 18 stories high—is the largest clock in the world, with half-ton hands that can be seen clearly six miles across Grant Park to the south.

Because of heavy daytime traffic, colors were selected to give best possible daylight visibility also.

The 15-foot letters of the secondary copy listing Motorola's products were installed complete, hoisted by an electric winch. Officials of the erection contractor believe this is probably the first time such large components have been raised in one piece.

A maintenance man will be on duty full time to keep the 12 miles of wiring, 10,220 lights and 10,000 feet of neon tubing functioning.

The sign was officially lighted late in November on signal to electricians from Executive Vice-President Robert W. Galvin's little daughter Gail. She spoke instructions into a 2-way "Handie-Talkie" transmitter from a vantage point at the Chicago Yacht Club, where representatives of Motorola, Federal Enterprises, Inc., and Commonwealth Edison Company gathered for the ceremony.

★

★

Gail Galvin gives the signal to electricians half a mile away to light the new Motorola sign on Chicago's Outer Drive at Randolph Street. Assisting with the "Handie-Talkie" is her father, Robert W. Galvin, executive vice-president of Motorola, Inc.

Each Truck Does 2 to 3 TIMES MORE WORK!

Driver calls in for next job. Instant contact keeps men and machines working. There's no waiting for instructions with Motorola 2-way Radio on the job!

Motorola 2-way Radio

enables chemical company* to reduce waste motion and waiting time—assures on-the-spot action when time is money!

Motorola 2-way Radio more than doubled material handling efficiency for a well known chemical company. Fork lifts and trucks—no longer tied up waiting for orders—do two to three times more work. Drivers get instructions without leaving their cabs—actually start after loads while still being briefed.

You, too, can cut costs and speed operations with Motorola 2-way Radio. Eight exclusive features guarantee precision selectivity . . . time-tested durability . . . obsolescence-proof design. Let a Motorola engineer in your vicinity give you the complete Motorola 2-way Radio story.

*Name in our files.

The trend is to MORE MOTOROLA 2-way RADIO for low-cost material handling!

national Motorola® RADIO COMMUNICATIONS service

Motorola Communications & Electronics, Inc.

A SUBSIDIARY OF MOTOROLA, INC.

4501 W. Augusta Blvd., Chicago 51, Illinois • Rogers Majestic Electronics Ltd., Toronto, Canada